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The Demand for Rental Housing: A Review of Theory and Empirical Evidence

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THE DEMAND FOR RENTAL HOUSING:

A REVIEW OF THEORY AND EMPIRICAL EVIDENCE

prepared for

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ABSTRACT

Residential rents, especially those for newly constructed dwellings, have risen quickly in recent years. Housing analysts, planners, and builders alike face a common question. How sensitive is the demand for rental housing to the price being charged? This report reviews the empirical evidence available. It begins with a review of methodological questions. How do we measure demand? How do we empirically define a "consumer"? How do we separate quality from price changes? How do we measure a consumer's "willingness to pay" or "ability to afford"? What form does a demand function take? The report examines the data sets on which most Canadian and U.S. studies are based. Subsequently, it presents a review of empirical estimates of the price sensitivity of rental housing demand. A set of conclusions are drawn which emphasize the need for better data and a more thorough and systematic analysis of housing demand in Canada.

This study was conducted by John R. Miron of the Centre for Urban and Community Studies, University of Toronto for Canada Mortgage and Housing Corporation under Part V of the National Housing Act. The analysis, interpretations, and recommendations are those of the consultant and do not necessarily reflect the views of Canada Mortgage and Housing Corporation or those divisions of the Corporation that assisted in the study and its publication.

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Preface

Within the past decade, housing demand research in Canada has entered a new level of sophistication. This work has been made possible by the public release of large micro-data files. I include here the 1971 and 1976 Census "Public Use Samples", the biennial "Household Income, Facilities, and Equipment" samples, the 1974 "Survey of Housing Units" sample, the 1977 "Incomes, Assets and Debts" sample, and the 1978 "Family Expenditure Survey" sample. In most cases, these samples were collected by Statistics Canada and were intended to serve a number of different uses. The samples are useful for housing demand research because each contains some data about household composition, income, and dwelling characteristics. Because these samples provide data about a large number of individual households, it is now possible for researchers to analyze housing demand at a very detailed level. In the past, this was not possible. Housing researchers simply did not have the financial resources to generate such large samples.

Almost all of the empirical studies described in this report have made use of micro-data files. After reading this report, the richness and value of these files should be evident. Without them, housing demand research in Canada would have been severely limited.

At the same time, we have come to recognize the limitations of these data sources. Being omnibus samples, they often do not contain enough housing-related data to suit our ever-growing data needs. We have learned much from these samples, but are fast reaching the stage where we need more. A particular shortcoming of these samples is that they are all cross-sectional: i.e. once-only samples of a set of households at a given point in time. As argued in this paper, there are many empirical issues in housing demand research for which longitudinal samples would be invaluable. A longitudinal, or panel, study follows a given set of households over time, periodically re-interviewing them. From such a sample, it is possible to look at how changes in income, or housing prices, or household composition translate over time into changes in dwelling occupancy. From a cross-sectional sample, one can only guess at such impacts. Some panel study data are available for the United States but none for Canada. This paper concludes with an appeal for the development of new panel study samples for Canada. Such samples would open up a new and rich area of exploration in housing demand research.

In closing, I would like to thank Canada Mortgage and Housing Corporation for its continued support and interest. Within CMHC, there have, over the years, been good numbers of people who recognized the importance and value of housing demand research. Without them, much recent work in Canada might never have been done.

Summary

How sensitive is the demand for rental housing to the price being charged? As construction costs rise, this question must be of some concern to the residential building industry. Higher rents presumably imply lower demands for a rental unit of a given set of characteristics and location. For the developer, a lower demand manifests itself in a longer 'rent-up' period or a persistent high vacancy rate. Anecdotal evidence abounds of particular buildings which were slow to rent-up or have a high vacancy rate. However, was this due primarily to price sensitivity or to some bad characteristic such as inferior building quality, inappropriate design, or inaccessible location?

Rent levels can not be considered in isolation. They must be related to changes in consumer income. The price sensitivity of rental housing demand in part also depends on the availability of substitutes. Consumers might substitute another kind (e.g. size, type, tenure) of dwelling that is almost as desirable, or substitute some housing for other goods altogether, or may choose an alternative living arrangement (as in "doubling up"). An assessment of the price sensitivity of demand should consider the feasibility of such substitutions. The ability to substitute will differ among households; therefore, their price sensitivities will vary as well.

Any examination of the price sensitivity of rental housing demand must consider three basic questions. (1) How does one conceptually measure the demand for housing? (2) How do prices and incomes shape this demand and how are these related to the ability to substitute? (3) How and why does the demand for housing vary among different demographic groups?

In this paper, the approaches of previous empirical studies to the above three questions are reviewed. Section 2 discusses some fundamental concepts in housing demand analysis; section 3 considers the formulation of a demand function; and section 4 reviews the empirical evidence on the sensitivity of housing demand to income and price changes. In the final section, some conclusions are presented.

The principal conclusions of this review are as follows:

(i) There is a paucity of Canadian research on rental housing demand.

(ii) In part, this is because of the lack of any longitudinal data sets by which housing demand can be analyzed at a micro level.

(iii) Any consideration of the demand for rental housing must simultaneously look at the demand for owner-occupancy because of the extent of substitution possible between these two demand forms.

(iv) Currently-available housing demand models vary greatly in their specification, thus limiting comparisons among them.

(v) Nearly all demand studies estimate the housing choices of existing households. The impact of a change in price on the decision of an individual or family to form a new household is ignored.

(vi) The ability to measure price sensitivity depends critically on the ability to factor rents into quality and price components. Several methods of measuring housing quality have been proposed: none of which are entirely satisfactory.

(vii) Most demand studies assume that the housing market is in economic equilibrium. However, this assumption has been widely contested. We do not know, however, how available price sensitivity estimates would change if this assumption were dropped.

(viii) There are several estimates available of price sensitivity. However, these estimates are based on several different measures of demand. Care must be taken not to incorrectly compare these different kinds of price sensitivities.

(ix) There is a considerable diversity in the measurement of income in housing demand studies. Although analysts agree on the need to measure 'permanent income', this can be defined in different ways. This limits comparisons of income elasticities and price sensitivities.

(x) There are substantial differences in price sensitivity among cohorts of households. In terms of their tenure choices, and other aspects of their demand for housing, young husband-wife families appear to be the most price sensitive.

THE DEMAND FOR RENTAL HOUSING:
A REVIEW OF THEORY AND EMPIRICAL EVIDENCE

1. INTRODUCTION

How sensitive is the demand for rental housing to the price being charged? As construction costs rise, this question must be of some concern to the residential building industry. Higher rents presumably imply lower demands for a rental unit of a given set of characteristics and location. For the developer, a lower demand manifests itself in a longer 'rent-up' period or a persistent high vacancy rate. Anecdotal evidence abounds of particular buildings which were slow to rent-up or have a high vacancy rate. However, was this due primarily to price sensitivity or to some bad characteristic such as inferior building quality, inappropriate design, or inaccessible location?

Rents, of course, have not increased in isolation. Incomes have also been rising. A rent that was thought to be unaffordable a decade ago might now be considered modest. Therefore, we must examine rent levels in relation to incomes. Indeed, it has been argued that one way of forecasting the demand for rental housing at a given rent is by projecting the incomes of renter households and then calculating what, for them, might be an 'affordable' rent. In this paper, such approaches are evaluated.

The price sensitivity of housing demand in part depends on the availability of substitutes. If the price of a certain kind of housing increases, consumers will attempt to substitute a less expensive alternative. What might that alternative be? It could take several forms. First, the consumer may substitute another kind (e.g. size, type, tenure) of dwelling that is almost as desirable. Second, the consumer may subtitute some housing for other goods altogether: for example, giving up a larger house to live in a smaller one but taking more-frequent vacations. Third, the consumer (i.e. the person or persons making up the consuming unit) may either disband or not form. For example, a young woman might want her own apartment but instead choose (substitute) to remain in her parents' home if rents are too high. An assessment of the price sensitivity of demand should consider the feasibility of such substitutions. Note that the ability to substitute differs among households; their price

sensitivities will, therefore, vary as well.

Any examination of the price sensitivity of rental housing demand must consider three basic questions. (1) How does one conceptually measure the demand for housing? (2) How do prices and incomes shape this demand and how are these related to the ability to substitute? (3) How and why does the demand for housing vary among different demographic groups?

In this paper, the approaches of previous empirical studies to the above three questions are reviewed. Section 2 discusses some fundamental concepts in housing demand analysis; section 3 considers the formulation of a demand function; and section 4 reviews the empirical evidence on the sensitivity of housing demand to income and price changes. In the final section, some conclusions are presented.

2. FUNDAMENTAL CONCEPTS

There are numerous economic studies of markets. In a simple version, we can imagine a demand curve which relates the quantity demanded to the price paid. We can also imagine this demand curve shifting with changes in the income of a consumer. A supply curve showing the quantity of the commodity supplied at different prices can be superimposed on the demand curve. A market equilibrium is defined where these two curves intersect. Changes in the equilibrium price and quantity traded can then be traced to factors that cause shifts in the demand or supply curves.

In principle, this paradigm can be used to discuss housing as much as any other commodity. However, several questions must be faced in applying this paradigm. (1) How does one measure the demand for housing by a consumer? (2) How does one define the relevant consuming unit: i.e. the individual or group of individuals whose demand is being measured? (3) How relevant is the assumption of market equilibrium in the market for housing and what are the implications of assuming disequilibrium? (4) How does one measure or estimate the household's ability to afford or willingness to pay for a given dwelling? (5) What sources of data can be used in the analysis of housing demand and what are their limitations? (6) How does one measure the price of rental housing in a way which controls for quality (i.e. amount demanded). (7) How do changes in income affect the conconsumer's demand curve?

2.1 MEASURING A CONSUMER'S DEMAND FOR HOUSING

In conventional market analyses, the demand by a consumer in a given period of time is often an amount: e.g. five loaves of bread, eighty litres of gasoline, or two shirts. In the case of housing, the demand is usually just one dwelling (although some consumers do demand two or more dwellings). In the market for housing, a consumer's demand is usually measured in terms of quality rather than number of dwellings. By quality is meant any of the bundle of attributes that are usually considered desirable: e.g. floor area, number of rooms, number of baths, quality of construction, architectural design, built-in features such as central air conditioning, site and neighbourhood characteristics, and proximity to work, schools, and shopping. However, because quality has many attributes, there is no obvious single index number representing the quality of a given dwelling. How then do we measure the housing demand of a given consumer?

This is not a problem unique to housing markets. There are many commodities where the consumer chooses only one and thus where demand is measured in terms of quality rather than quantity. A variety of approaches have been developed to the problem of measuring consumer demand and several of these have been carried over to housing research. Four that are commonly used are the 'expenditures', the 'price discounting', the 'measured quality', and the 'discrete choice' approaches. Let us consider each of these in turn. Subsequently, let us consider a recently-developed 'simultaneous demand' approach which combines pairs of these four approaches.

2.1.1 THE EXPENDITURES APPROACH

Perhaps the simplest approach is to equate demand with expenditures. The more the household spends on housing, the greater its demand. This approach has been used by Lee (1968: pp 485-486), Lowry et al (1971: pp 55-74), Struyk (1976: p 144), Hanushek and Quigley (1979: pp 99-100), and Steele (1979: pp 171-198). Is it correct to refer to expenditures as demand? Most analysts sidestep this by not referring to their work as demand modelling. Steele (1979: p 171), for example, refers simply to a 'housing expenditure decision'.

The problem with this approach is that it confuses price with expenditure.

In the conventional economic paradigm, price (p) is the amount paid per unit consumed. If q units are consumed, then expenditure is the product 'pq'. In a conventional demand model, q is the dependent variable and p is an explanatory variable in a demand model. This mode of analysis is not feasible in housing market research because generally only one unit of housing is consumed per household. However, it is not clear that pq can be substituted as the dependent variable in a demand model in the absence of q.

The formulation of demand models is discussed at length in Section 3. Here, let us simply note that a common form is

$$(1) \qquad q = f(p,y,x,z)$$

where y is income, x is a vector of prices of other commodities, and z is a vector of preference parameters. [Usually one price is taken as numeraire and y, p, and x are in ratio to this.] In housing market research where expenditures are the dependent variable, the following model is typical:

$$(2) \qquad pq = f(y,x,z).$$

However, this latter model assumes that expenditures are a function only of the consumer's characteristics (y and z) and other prices (x). The fact that a consumer's willingness to spend is also a function of the desirability of the dwelling is ignored. A developer would be very unwise to consider using a model such as (2) to predict the rent-paying ability of prospective tenants without simultaneously considering the characteristics of their dwelling choices.

2.1.2 THE PRICE DISCOUNTING APPROACH

A second approach discounts the rent expenditure of a household by some price index value. Discounted expenditure is intended to be a measure of the quality of the dwelling occupied. Proponents typically argue that each rental unit can be assigned a quality level, Q. Often, rental units providing an 'average' bundle of services are assigned a Q = 1 while those providing 'better' or 'worse' bundles have Q's which are larger or smaller than unity respectively. Suppose further that each rental unit commands a rent which is proportional to

its level of Q. In other words, the 'price' of each unit of quality is some fixed amount, say P. If the rent expenditure for a particular unit is r dollars per month, and its bundle of services provided is Q, then $r = PQ$. If P were the same for each dwelling, then rent expenditure would be proportional to quality and the expenditures approach described above could be used. However, the rent for a unit bundle of housing services will not necessarily be the same for all dwellings. It might well vary geographically or with the type of dwelling being constructed. If we knew for example that a dwelling of the same characteristics rented for $400 per month in Oshawa but $360 per month in Barrie, we could deflate rents paid in Oshawa by 10% and assume that any remaining variation in rents either within Oshawa or between it and Barrie reflects quality differences. This is the price discounting approach.

Three different methods of price discounting have been used: metro-wide discounting, cost function discounting, and hedonic price discounting.

(1) Metro-wide Discounting. Several analysts have used metro-wide discounting in cases where the dataset includes households from a number of different metropolitan areas.[1] An average rent expenditure is calculated for each metropolitan area. Then, the rent expenditure of each sampled household in that metropolitan area is divided by that average rent; this ratio becomes the quality measure. For example, if a consumer spends $300 per month on rent when the average for that metro area is $240, it is assumed that 300/240 = 1.25 quality units are consumed. The problem with this method is that it assumes (i) that the only price variations are between cities and (ii) that average-priced units are comparable in quality in each city.

(2) Cost Function Discounting. Cost function discounting has not been used to date in rental housing demand studies. Polinsky and Ellwood (1979) have used a cost function approach to measure the quality of owner-occupied housing, however. In this approach, a production function is assumed for housing (Polinsky and Ellwood use a CES function). By assuming competitive markets and profit-maximizing landlords, one can derive a cost function showing the marginal cost per unit quality as a function of input prices and technical parameters. By further assuming a competitive market for housing in equilibrium, the marginal cost must be the same as the price per unit quality. Dividing this unit price into the selling price yields the quality level of the dwelling. A

similar approach could be used for rental housing. The advantage of this approach is that it permits a measurement of the impact of variations in building technology, zoning, and the costs of land, construction materials, and labour on the price of housing within and between metro areas. Its disadvantage is the necessity of assuming a housing market which is competitive and in equilibrium.

(3) Hedonic Price Discounting. Several analysts have used a hedonic price discounting method.[2] Consider, as an example, de Leeuw and Struyk (1975). They estimate a hedonic price equation in which rent expenditures are related to dwelling characteristics, using a metro-wide sample. Then, the metro area is divided into geographic zones and the hedonic price equation is applied to the set of mean dwelling characteristics for each zone. This yields a hedonic estimate (r1) of the average rent for a dwelling, which is then compared to the actual average rent (r2) in that zone. The rent expenditure (r) of each household in a given zone is multiplied by the ratio of r1 to r2. The de Leeuw-Struyk method eliminates spatial variation in rents by making the discounted rents $(r)(r1)/(r2)$ comparable from one zone to the next. How well the method works depends partly on how well the hedonic price function is specified: i.e. whether the dwelling characteristics that affect rents have been adequately and correctly specified. It also depends on the purpose of the hedonic price function. The de Leeuw-Struyk method can be criticized because it eliminates spatial variations in rents when these might be arising because of locational considerations and therefore reflect quality differences (as defined here) rather than price differences.

All of the above methods have some potential and some problems. The fundamental difficulty is that the construction of a quality measure is essentially an indexing problem. There are many different attributes of a bundle of housing services which have to be combined via weights into a single value (the index). What weights are to be used? How much does extra floorspace, better quality of construction, or a better location each contribute to this index of quality? Are there constant marginal contributions or does the quality level change nonlinearly with any of these? Are there joint effects; in other words, does the marginal contribution of extra floorspace depend on location for example?

The weighting scheme to be used must reflect consumer preferences. Presumably these weights are implicit in the rents consumers are willing to pay for different units. However, these weights may also vary among consumers. The young large family may put a large weight on outdoor play space whereas the older empty nester couple may not. If weights do differ among groups of consumers, how is a quality measure to be derived?

2.1.3 THE MEASURED QUALITY APPROACH

It is possible to measure some aspects of housing quality directly. These include floor area, number of rooms and lot size (for dwellings with private, ground-level outdoor space). For example, Miron (1980 and 1982) and Wilkinson (1973) measure the income elasticity of the demand for rooms and for floor area. Kain and Quigley (1975: pp 231-255) estimate demand functions for the number of rooms, the number of baths, the first-floor area, the parcel area, and newness (years since construction). Straszheim (1975) estimates demand functions for number of rooms and lot size. Provided that the quality aspect of interest can be measured in this way and provided that other quality attributes are not important, this approach is valuable.

2.1.4 THE DISCRETE CHOICE APPROACH

The last approach is to treat the demand for housing as a problem in discrete choice. A consumer might be seen to choose between two alternatives: e.g. owning vs renting, detached dwelling vs some other, large vs small dwelling, or central vs suburban location. Several housing demand studies have looked at such binary choice problems.[3] In addition, it is possible to look at multiple choice problems: e.g. choosing among several different sizes of dwelling or choosing a particular dwelling type and tenure combination.[4] Logit, probit, and other statistical models can be used to relate the choice of dwelling to incomes, prices, and consumer preferences. Such models can then be used to predict the probability that a consumer will choose any alternative over the rest. When aggregated over the entire population of consumers, these probabilities indicate the demand for particular categories of housing.

The discrete choice approach, unlike price discounting, appears to avoid the quality index problem. This is true in the sense that the discrete choice

methods do not require rent expenditure discounting. However, these methods model demand only for those quality attributes that are detailed by the choice alternatives. In discrete models of tenure choice, for example, other attributes of a dwelling such as quality of construction, design, or location are ignored.[5]

2.1.5 THE SIMULTANEOUS DEMAND APPROACH

In recent years, a simultaneous demand approach has been developed which combines the discrete choice approach with one of the earlier three. Typically, these studies model (i) tenure choice and (ii) housing expenditures or quality. Proponents argue that housing attributes are not available in whatever combinations the consumer wants. If the consumer wants a dwelling of a certain size and quality in a specific location, he or she may find that the units available are all owner-occupier or all rental units. The consumer may prefer one tenure but choose the other in its absence.

The empirical evidence on demand simultaneity is scattered and conflicting. Struyk (1976: pp 143-149) is among the earliest to attempt a joint estimation. He looks at the tenure and housing expenditure choices of households using two-stage least-squares. He finds that the effect of income on tenure choice is considerably reduced once the housing expenditure decision is taken into account. An alternative statistical approach (using two-stage maximum likelihood) has been developed by Lee and Trost (1978). They do not find the income effect noted by Struyk. They find only weak evidence of a simultaneity between tenure and housing expenditure choices. Rosen (1979a) and Boehm and McKenzie (1982) also use the Lee-Trost procedure, but on different datasets. They again find only weak evidence of simultaneity between tenure and (price-discounted) expenditure. King (1980) uses a different estimation method (also based on maximum likelihood) and finds that simultaneity has a significant effect.

It still remains to be seen whether a simultaneous approach to demand estimation is superior to the traditional approach. There is, arguably, some simultaneity present but it is unclear whether this is numerically extensive enough to be important.

2.2 DEFINING THE RELEVANT CONSUMING UNIT

A household is defined in the Census of Canada to be the collection of individuals occupying a dwelling unit. It is not uncommon to begin an analysis by assuming that each household is a consumer. The housing analyst might begin by putting each household into a economic-demographic group and then examining the housing demands of each group. This is the prevalent approach to demand analysis and forecasting today.

However, the existence of a household is itself conditional upon the price of housing. Consider, for example, a young bachelor starting his first job. Depending on various circumstances, this person may (1) continue living in his parents' home, (2) live as a lodger in someone else's dwelling, (3) rent a dwelling on his own, (4) share a rented dwelling with one or more partners, or (5) purchase a dwelling and perhaps rent out space in it to lodgers or partners. This person's choice will depend on the prices of each form of accommodation as well as on several other considerations: e.g. his income, preferences, future housing requirements, proximity of dwelling to jobsite, expectations about future house prices, and wealth. If he chooses alternative (1), no new household is formed. However, if the price of some other form of accommodation is low enough, he may find it desirable to change his living arrangement and thus contribute to an increased demand for that form of accommodation.

The problem here is that the household is an elastic measure in housing demand studies. One cannot measure price sensitivity of rental demand by looking simply at how a given set of households change their tenure and dwelling choices. One must also look at how the number and composition of households are affected by price changes. However, there has not been any empirical work to date on such price impacts. In the work of Steele (1979), Miron (1980), and Miron (1982), income is shown to have substantial impacts on the number and composition of households. To the extent that affordability reflects a tradeoff between incomes and prices, this latter evidence may well imply that price impacts are substantial.

2.3 EQUILIBRIUM AND DISEQUILIBRIUM IN THE HOUSING MARKET

Much of the literature presumes that the housing market is in a state of short run economic equilibrium.[6] In other words, the rent being charged for

any kind of occupied dwelling is just enough to make the demand equal to the supply. No tenant has an incentive to change dwellings and no landlord has an incentive to withdraw a dwelling from the market, to add a new one, or to seek a new tenant. Let us refer to such rents as the equilibrium rents.

2.3.1 WHY DISEQUILIBRIUM?

At any point in time, however, the housing market likely will not be in equilibrium. In other words, market rents diverge from equilibrium rents. The durability of the housing stock, the absence of perfect information among market participants, the costs of moving, and exogenous changes in market conditions over time are often cited in suggesting that equilibrium may never be exactly attained. This does not mean that the housing market bears no resemblance to an equilibrium. In broad terms, market and equilibrium rents may be similar. However, disequilibrium could be expected to introduce at least small differences between these two.

The notion of short-run economic equilibrium is inherently static. If the market were for an instant in such an equilibrium, there would be no movement of households because there would be no incentive for a rational household to move. Any rental unit which was vacant would remain so and no occupied dwelling would be vacated. The notions of rent-up periods and vacancy rates would be meaningless.

It is specifically because of disequilibrium that the notions of rent-up period and vacancy rates become meaningful. A developer puts up a building in the belief that there will be a demand for it, either among newly-forming households or among already-existing households who are dissatisfied with their current accommodation. The developer asks a certain rent for each unit. This asking rent is typically set without perfect knowledge of the equilibrium rent. If the asking rent is equal to the equilbrium rent and if the housing market is otherwise almost in equilibrium, the unit should rent up quickly and have a low vacancy rate. Even here, though, the landlord cannot expect zero rent-up periods and zero vacancy rates as it takes time for information to disseminate in the market and for the right tenant to appear. However, if the asking rent is substantially above the market rent, there will be a larger rent-up period and higher vacancy rate. It will take longer to find a tenant to fill the unit

and, once there, the tenant is more likely to continue searching for a less expensive unit or one of better quality. The problem for the landlord is to find a profit-maximizing rent level; a level which trades off rents received while rented against the likelihood of vacancy.

2.3.2 MODELLING DISEQUILIBRIUM

Few empirical studies of housing markets specifically allow for disequilibrium. Among those that do, two categories of studies may be identified. In one category, disequilibrium is present because a household is unable for some reason to choose the dwelling it wants even though it is willing to pay the price charged. King's (1980) study of the U.K. housing market exemplifies this category. In the second category, disequilibrium arises because a household is slow to respond to an unsatisfactory housing assignment even though more satisfactory housing is available. Let us consider each of these in turn.

King (1980) argues that the U.K. housing market can be divided into three sectors: subsidized rental, unsubsidized rental, and owner-occupied. He argues further that households are not free to enter the subsidized rental sector because access there is controlled by local housing authorities. Access to the owner-occupied market is also restricted, he argues, by the availability of credit. A model is constructed in which each household makes a utility-maximizing choice among the three sectors subject to the constraint that access to a given sector may be rationed, forcing the consumer into a less desired form of accommodation. King uses a sophisticated maximum likelihood technique to estimate a housing demand function on this basis.

Hanushek and Quigley (1979 and 1980), Rosen and Rosen (1980), and Friedman and Weinberg (1981) are examples of studies wherein the consumer is assumed to adjust slowly to changes in its equilibrium demand for housing. Suppose the price of a certain kind of housing were to rise suddenly. These studies argue that the response of tenants would not necessarily be immediate. Some households might move quickly to a more preferred unit. For others, however, the costs of giving up an old neighbourhood, searching for information about new rental units, or moving might be too great. They would not move immediately but might choose to move later on, either as the difficulty of maintaining their

present residences became more evident or as other conditions changed to further encourage a move. Thus, the sensitivity of demand to price change may be considerably smaller in the short run than when considered over a longer term. In general, these studies assume (i) that there is an equilibrium demand for housing, (ii) that this demand is related to the household's income and other characteristics and to the prices of housing and other goods, and (iii) that the change in a household's consumption of housing over time is proportional to the discrepancy between its actual consumption and its equilibrium consumption.

2.3.3 MOVERS VERSUS NONMOVERS AND DISEQUILIBRIUM

Others allow for disequilibrium by distinguishing between consumers who have moved recently and others who have not. Commonly, it is argued that movers are more likely to be living in their most preferred dwellings. Over time, it is argued, a consumer's preferences do change but that, for the reasons discussed above, the consumer may be reluctant to change its dwelling. However, when a household does finally move, it makes a choice based on its current preferences.

On the basis of such arguments, several analysts have restricted their attention to recent movers.[7] Ihlanfeldt (1981) reports differences in estimated housing demand functions (the dependent variable being discounted housing expenditures) for recent movers compared to nonmovers. In particular, the demands of nonmovers were found to be less sensitive to income and prices. Lee and Trost (1978) and Stevens (1979) used all consumers in their studies but did include in their demand functions an independent variable indicating a recent or near-future move. Lee and Trost found that households that move often are more likely to rent and that recent movers are also likely to spend more on rent than are nonmovers; in both cases, this is holding constant demographic and income characteristics of the consumers. Stevens found, however, that recent or near-future residential mobility did not affect rent expenditures.

Muth (1974), Straszheim (1975), and Steele (1979) criticize the reliance on mover data on several grounds. First, it is argued that housing choice is anticipatory. A consumer who selects a new dwelling takes into account how that housing will compare to the consumer's emerging needs over the expected length of residency. The young husband-wife pair anticipating children, for example,

will take that into account in choosing their housing now. Second, it is argued that moves of renters into owner-occupied units are related to the availability of credit, the transactions costs of moving, and the consumer's expected duration of residency. When such a household moves and what kind or size of dwelling it occupies are conditioned by these factors as well as by preferences, prices, and income. Muth also discusses how the depreciation of housing over time will lead a rational consumer to initially 'overconsume' housing. In Muth's view, looking only at movers tends to overstate the demand for housing and its sensitivity to income because of this. These three analysts conclude that it is not apparent a priori whether recent movers are any closer to their current equilibrium demand than are nonmovers. Straszheim (1975: p 8) concludes that 'while mover and nonmover cross-section samples lead to different results, it is not clear that a sample based only on recent moves provides more information or is the preferred specification'.

2.3.4 SHORT AND LONG-RUN DEMAND ELASTICITIES AND DISEQUILIBRIUM

Inherent in the notion of disequilibrium is a 'period of adjustment'. The period of adjustment is the time required for a housing market to return to an equilibrium after being disequilibrated. It is commonly argued that housing markets are slow to equilibrate although there is only scanty empirical evidence on this. The following exemplifies this.

Hanushek and Quigley (1980) construct a partial adjustment model of housing demand that distinguishes between a 'desired' housing consumption level and an actual level. The 'desired' level is supposed to reflect the preferences of the consumer as well as income constraints; it is the level of housing consumption toward which a consumer with those preferences and income will tend regardless of current consumption. Hanushek and Quigley (1980: p 451) find that, among low income renters (including movers and nonmovers) in Pittsburgh and Phoenix, only 20% to 35% of the gap between 'desired' and actual consumption is closed in one year. Friedman and Weinberg (1981: pp 322-326) take exception to Hanushek and Quigley's analysis. They argue that the way in which Hanushek and Quigley measure the desired housing consumption level does not take into account individual variations. The gap thus appears to close more slowly than it does. Using similar data, but restricting themselves to movers and allowing crudely

for individual variations in desired housing consumption levels, Friedman and Weinberg find that 100% of the gap is closed each year.

If the housing market does not immediately adjust back to equilibrium, the measured demand elasticity depends on the time span over which the measurement is made. Suppose for example that (i) a consumer's income elasticity is 0.8 , (ii) the consumer closes 25% of the gap in one year, (iii) the consumer is initially in equilibrium, and (iv) the consumer's income suddenly rises to a level 20% higher than before. The 'desired' consumption level thus rises by 0.8 x 20% = 16%. The actual consumption level in each year is as follows (standardized to equal 1.00 at initial equilibrium).

Years Elapsed	0	1	2	3	4	5	6	...	∞
Actual Consumption	1.00	1.04	1.07	1.09	1.11	1.12	1.13	...	1.16

In this case, the consumer is only about 3/4 of the way to its desired consumption level five years later. If we were measuring the income elasticity of demand by using observed changes in housing consumption over a five-year time period, we would thus miss 1/4 of the income-induced change. If only a two-year period had been used, less than one-half of the change would be detected.

The above example is merely intended to be illustrative. The rate of adjustment may be higher or lower than the 0.25 value used here. The important point here is that, unless the market adjusts very quickly to a given change, measured sensitivities will depend on the time span over which the measurements are taken.

2.4 ABILITY TO AFFORD AND WILLINGNESS TO PAY

How much might a given household be willing or able to pay to rent a particular dwelling? In a sense, there are two distinct questions here. How much a household is able to pay is a normative question; how much a household is willing to pay is behavioural. In assessing the price sensitivity of rental housing demand, we are presumably more interested in the behavioural question. However, answering the normative question under certain assumptions can give an upper limit on an answer to the behavioural question.

There are two distinct empirical approaches to the question of what a

household can afford to pay for housing. One is a 'minimum budget' approach. In it, a basic bundle of necessities (e.g. food, clothing, health care) excluding housing is costed taking into account the household's size, composition, and geographic location. The difference between the household's income and its costed basic bundle is its ability to afford housing.[8] Inherent in this approach are value judgements about 'necessities' versus 'non-necessities' and about the minimum level of well-being that everyone in society should be able to attain.

The second approach uses 'rent-to-income' ratios. Commonly, spending up to 25% of a household's income on rent is thought to be affordable although other threshold percentages have also been employed.[9] Usually, the same threshold percentage is used for all households even though the minimum budget approach might suggest different thresholds depending on the household's characteristics. The choice of threshold is arbitrary and presumably reflects a value judgement about the expenditure on housing that is reasonable for a household relative to its income.

What a household is willing to pay for a given unit of housing is another question altogether. In principle, the household would prefer to spend as little as possible for any given rental unit. Given its income and a particular configuration of rents for different units, the household may be willing to pay more. However, there is presumably a rent beyond which the household would prefer some other dwelling. This rent represents the household's willingness to pay. It is determined partly by the quality of the dwelling unit, its design attributes, and its location; partly by the household's income and preferences; and partly by the availability and spatial configuration of alternative dwellings.

2.5 SOURCES OF DATA

What kinds of data are needed or available for the estimation of a consumer demand function? The formulation of a demand function is discussed in detail in Section 3. To summarize here, the demand function should show how the quantity demanded is related to the price being asked. It should also show how the consumer's income and housing preferences and the prices of other goods also affect the demand for housing. Typically, a demand function is never exactly

observed. What we do observe are the housing choices of consumers, their incomes, household compositions, and housing expenditures. Can a demand function be derived from these data?

Most analysts would answer affirmatively provided that the housing market is in equilibrium as described in Section 2.3 above. If the housing market is not in equilibrium, then a consumer is occupying one unit at a certain going price whereas he or she would prefer to occupy some other unit at its going price. The housing choices of such consumers would not therefore represent points on their demand curves.

The typical source of data for a housing demand study is a set of household interviews. Questions are asked of each household, often in regard to its demographic composition, income, expenditures, location, and tenure and other characteristics of the dwelling occupied. Most of these surveys are strictly cross sectional, covering only some current period. Others are cross sectional but include questions about the previous history of the household or about its near-future plans. Still others are longitudinal surveys which follow households over a number of years, reinterviewing them from time to time to measure how their conditions have been changing.

These typical data sources are, however, often inadequate in at least three major respects. As discussed in Section 2.2 above, a study of housing demand must look at more than just existing households. It must also examine the propensity for new households to form, and the relationships between household formation and prices and incomes. This necessitates data for individuals who might form households as well as for existing households. Datasets which contain both individual and household information are uncommon.

The second inadequacy is that data are almost never collected on the housing alternatives that were not chosen by a consumer. Ordinarily, only information about the current residence, i.e. the chosen alternative, is recorded. To be fair, it is not likely that households would be able to recall accurately what the costs and the attributes were of the other alternatives. However, the consumer's demand for a particular dwelling will depend on the prices of the alternatives. In practice, housing analysts either ignore the prices of alternatives altogether or else assume that these prices can be somehow estimated from the choice data for other households. Neither approach may be very satisfactory.

The third inadequacy is that most of these are cross sectional, not panel study data. In a cross sectional study, the household is interviewed only once. In a housing demand study, the household's choice of dwelling is then compared with the choices of peers facing different prices or having different incomes. The assumption made is that if the household had the same income or faced the same prices as its peers then its choice would also be similar. However, this assumes that we can identify a household's 'peers'. In a panel study, the same household is reinterviewed on several occasions. Changes in the household's income, changes in the housing prices facing it, and changes in the household's composition and housing preferences can also be measured. These can then be related to any actual change in housing consumption. This is stronger. With a panel study, we can say, for example, that a consumer changed dwelling in conjunction with a change in income. With a cross sectional study, we can merely conclude that, if Smith's income rises to the level of Jones', it is reasonable to expect that Smith will live in a similar dwelling because Smith and Jones are otherwise similar (i.e. peers). Unfortunately, there are very few panel studies available of use to housing demand research.

Let us now review some of the principal data sources for housing demand studies in Canada and the United States. Some American data sources are much better than anything currently available in Canada and the purpose in reviewing them is to illustrate how Canadian data might be improved.

2.5.1 DATA SOURCES IN CANADA

In Canada, only three datasets have been widely used to date. These are Statistics Canada's Census Public Use Sample (PUS) files (currently available for 1971 and 1976), Statistics Canada's Household Facilities, Income, and Equipment (HIFE) files (currently available every other year from 1972 to 1980), and CMHC's Survey of Housing Units (SHU) file (conducted in 1974). All are cross sectional samples.

The HIFE files are samples of households drawn from across Canada. From 1972 to 1976, there are about 15,000 households per survey in the file. In 1978 and 1980, there are about 30,000. The data collected for each household varies slightly from one year to the next, but include information on a household's demographic composition, income, and (except in 1978) rent paid (if any). Early

HIFE files also detailed the expected selling price and presence of mortgage for owner-occupiers but such data are no longer included in the file.

The HIFE files contain no information about past changes or expected future changes in the household or its composition. They also contain virtually no information about individuals other than the head of a household or spouse (if any).

The PUS files are produced in three versions: individual, family, and household. Each is a 1 in 100 sample for nine provinces (Prince Edward Island and the two northern territories are not represented in these samples). The PUS household files are somewhat larger than HIFE. In 1976, they included about 71 thousand households. The PUS household files and the HIFE files include several variables that are identically or similarly defined and this makes it possible to do some empirical comparisons between them. The PUS files, however, have two substantial advantages over HIFE. First, it is possible to look at the living arrangements of individuals and families, regardless of whether they are maintaining a household or not. Thus, it is possible to contrast the incomes, for example, of persons who live in certain kinds of households with the incomes of those who choose other alternatives. Second, the 1971 PUS does include information about the duration of residence and previous tenure. This is valuable in the context of the discussion on movers versus nonmovers and disequilibrium (see Section 2.3). Unfortunately, there are no other details of the household's previous composition, income, or housing choices. The 1976 PUS file does not contain any information of this type.

Canada Mortgage and Housing Corporation's 1974 Survey of Housing Units is perhaps the most detailed study of households and their housing in Canada. It is a sample of about 63 thousand households. It is drawn from only the 23 largest urban centres in Canada. Not being a national sample restricts its comparability with PUS and HIFE files. As with HIFE, SHU is a sample of households only. However, the SHU file includes detailed information on the demographic and income characteristics of every individual in a sampled household. This permits the construction of an 'individual file' for SHU that can be used to examine housing demand arising from household formation. In addition, the SHU file is unique in that it contains very detailed information on the previous dwelling and household for recent movers. SHU provides information on the previous dwelling, the composition of the household living

there, and selected financial aspects such as rent and mortgage payments.

2.5.2 DATA SOURCES IN THE UNITED STATES

Much of the U.S. research on housing demand has relied on cross sectional data. In his pioneering work, David (1962) used the Survey of Consumer Finances. De Leeuw and Struyk (1975) and Struyk (1976) relied on the 1970 Census Public Use Sample. Straszheim (1973 and 1975), Kain and Quigley (1975), Quigley (1976) used cross sectional samples from San Francisco, Saint Louis, and Pittsburgh respectively. Follain (1979 and 1982) used the Annual Housing Survey for 1975. Bossons (1978) employed the Federal Reserve Board's 'Survey of Financial Characteristics of Consumers' from 1963. In addition, several studies were based on mortgage application data -- Maisel et al (1971), Smith and Campbell (1978), Polinsky and Ellwood (1979), and Rosen (1979b) -- which were cross sectional, although nonrandom, samples. In addition to being cross sectional, the basic observational unit appears to be the household.[10] Thus, these data sources preclude an analysis of the responsiveness of household formation to changes in income or prices as discussed above in Section 2.2.

The most widely-applied panel dataset in U.S. housing demand studies is the 'Panel Study of Income Dynamics' (PSID) by the Survey Research Center of the University of Michigan. This is a unique study which has followed a sample of families since 1968. It is possible in this study to examine how income and family composition changes over the years have been associated with changes in dwelling characteristics. Among the users of the PSID have been Carliner (1973), Lee and Kong (1977), Roistacher (1977), Lee and Trost (1978), Rosen (1979a), Ihlanfeldt (1980 and 1981), Boehm (1981), and Boehm and McKenzie (1982).

A smaller group of studies have employed reinterview data from the Housing Allowance Demand Experiment (HADE) conducted by the U.S. Department of Housing and Urban Development in Pittsburgh and Phoenix.[11] Under HADE, a social experiment was conducted in which a sample of low income households was divided into two groups. One group received direct housing subsidies of from 20 to 60 percent of their rent payments for a period of time; the other group received no subsidy. Households were reinterviewed annually. The HADE data provide a relatively unique source of information on housing demand, at least on low

income households. These data have been used by Hanushek and Quigley (1979 and 1980), Friedman and Weinberg (1981), Mayo (1981), and Cronin (1982).

Finally, Lee (1968) used reinterview data from the Survey of Consumer Finances from 1960 to 1962 in a housing demand study. This appears to have been the only use of the Survey of Consumer Finances on a longitudinal basis.

These three panel datasets are unlike anything available for Canada. They give analysts the ability to examine changes in dwelling characteristics associated with changes in household characteristics, incomes, and prices for a given household. Because Canadian studies must rely on cross sectional data, it is not possible to study such linkages. We have to assume, perhaps incorrectly, that if a households's characteristics or income changes, it will change its dwelling to be like those of other households who already have that income and those characteristics. There is a need for a panel study in Canada to provide this kind of valuable data.

2.6 PRICE, QUALITY, AND DEMAND

In the conventional economic paradigm, a consumer's demand is a function of price. Price, in this case, means the dollar value attached to one unit of the commodity of a certain fixed quality. If quality were permitted to vary from one unit of the commodity to the next, there would not be a simple relationship between demand and price. However, this is exactly the problem in housing demand. Quality does vary among units of housing. Comparing the rents of two units of different quality levels is meaningless in the absence of quality information.

Suppose a discrete choice approach (as discussed in Section 2.1.3 above) is being used. Suppose for the moment that the consumer is an already existing household considering moving into a rented detached house (choice a) or a rented apartment (choice b). Other things being equal, the household will base its choice on the rents being asked, r_a and r_b, and the quality levels, Q_a and Q_b, of the two choices respectively. Either choice generates a utility level for the consumer. In both choices, there is the utility arising from consumption of housing of that quality and utility which arises from spending the remaining income on nonhousing commodities. A rational household chooses the dwelling associated with the higher utility level. If choice 'a' has

a higher rent, the individual would choose it only if the extra utility gained from consuming its higher level of quality exceeds the loss in utility arising from decreased expenditures on other commodities.

While this decision criterion is simple enough in concept, it is exceptionally difficult to implement in practice. As discussed in Section 2.1.2 above, there is no obvious quality measure that can be used to rank preferences. Further, there are likely to be some differences among the preferences of consumers that lead to alternative quality measures for the same dwelling.

An additional complication arises when tenure choice is considered. In the above example, the choice is between two rental units. If the problem is extended to allow for a third option, owner-occupancy of some dwelling, then one must examine both the consumption value of housing (as we have done above) and its asset value. What is the 'price' of a given owner-occupied housing unit? Here, one must take into account any mortgage interest payments, maintenance and property tax costs, and expected capital gains upon disposal. These costs arise at different points in time and with some uncertainty. They thus necessitate some consideration of both risk-bearing and the discounting of future versus present-day costs. Also, the 'price' of owner-occupancy should reflect the income tax advantages, the nontaxation of (1) imputed rental income and (2) capital gains on a principal residence, accorded this mode of tenure.

In Section 2.1.2, we considered the notion of price by stating that rental value equals the product of quality and price (per unit quality). If demand is to be expressed in quality terms and if we are interested in the price sensitivity of demand, then a quality-price decomposition of rents is essential. In Section 2.6.1, we ask why there are price differentials among dwellings. In Section 2.6.2, some empirical research work is considered in which price and quality differentials are ignored (or assumed to be nonexistent). Section 2.6.3 discusses other work in which quality variations are considered but price variations are not. Finally, still other work in which price variations are specifically considered are discussed.

2.6.1 WHY DO PRICES VARY?

What would a market look like without any housing price differentials. Without price differentials, the difference in rent between any pair of housing

choices strictly reflects quality differences. To have no differentials, several conditions would have to be met. For one, the building industry would have to be perfectly competitive in all markets; every builder would be able to purchase inputs at exactly the same prices. There would have to be a fixed building technology, universally known, with constant returns to scale. Finally, the building industry would have to be in long-run competitive equilibrium. Muth (1971: pp 244-245) describes such a scenario; in it, the price of housing is driven to the minimum cost of production. With no excess profits in building, price differences among dwellings reflect only the differences in the housing services provided by each.[12]

In this treatment, rent differentials still arise because of locational considerations. Advantageous sites earn an extra rent even in long run competitive equilibrium. However, in a competitive equilibrium, these locational rent differentials generate a spatial equilibrium: the consumer being indifferent between a higher rent for a more accessible site and a lower rent at a less accessible site. We can think of these rent differentials as the 'price' of accessibility in this sense; accessibility is just another attribute of housing quality.

The objective here is not to argue whether or not there are price differences, but rather to suggest how price differences might emerge in the real world. The above discussion of a uniform price world helps to clarify this. If input prices (the costs of building materials, capital, labour, etc) were not the same everywhere, if building technologies differed, if zoning or building bylaws differed, or if the market were not in long-run equilibrium, then price differentials could exist. Also, if one did not accept the notion of accessibility as an attribute of housing quality, rent differentials associated with accessibility would imply corresponding price differentials.

We should also remind ourselves here that, when looking at tenure choice, the 'price' of owner-occupied housing will also depend on the consumer's initial equity, the mortgage rate, maintenance and property tax expenses, expected capital loss or gain, and the consumer's marginal personal income tax rate.

2.6.2 NO ROLE FOR PRICE OR QUALITY VARIATIONS

Several housing demand studies ignore price differentials altogether. This has been especially true in discrete choice models of tenure. Struyk (1976), Lee and Kong (1977), Li (1977), Roistacher (1977), Bossons (1978), Smith and Campbell (1978), Steele (1979: pp 123-169), and Ihlanfeldt (1980) are of this kind. They assume that tenure choice is a function of the household's characteristics (e.g. life cycle characteristics, income, assets, and household size) but not of the costs of owning versus renting.

Prices are also often ignored in the expenditures approach to housing demand. Lee (1968), Lowry et al (1971: pp 228-237), Byatt et al (1973), and Steele (1979: pp 171-198) regress housing expenditures against sets of variables that do not include price terms. De Leeuw (1971), Maisel et al (1971), Carliner (1973), de Leeuw and Struyk (1975), Lee and Trost (1978), Rosen (1979b), Stevens (1979), and Ihlanfeldt (1981) all use price discounting (as described in Section 2.1.2) to convert housing expenditures into a quality measure. However, none of these studies includes a price term on the right hand side of the demand function to show the sensitivity of demand for quality to price.

2.6.3 STANDARDIZING FOR QUALITY DIFFERENCES

Other studies do not include a price term but do differentiate among housing units based on quality levels. Two approaches have been employed.

One is to use dummy variables to represent quality on the right hand side of a demand function. This approach is pursued by Kain and Quigley (1975: pp 154-189) and Hanushek and Quigley (1979). They use housing expenditures as the dependent variable (without any price discounting) but include dummy variables for the presence of such items as landlord-supplied furniture, heat, appliances, or water. Presumably, the presence of these items raises the rents that tenants are willing to pay.[13]

Another approach was employed by Wilkinson. In a study of owner-occupier housing demand, he used house value per room and house value per unit floor area as the dependent variables. A similar approach is possible for renters. Wilkinson claims that this crudely adjusts expenditure for quality. It is unclear, however, in the subsequent analysis whether value divided by dwelling size is a measure of quality (better quality dwellings have a higher price per

room) or price (variation in price per room greater than could be expected from quality variation alone).

A problem with both approaches is that they do not permit an assessment of the impact of price change on demand. It is possible to calculate the rent increment associated with, say, the provision of heat in a dwelling or an extra room. It is not possible, however, to calculate how sensitive the demand for housing would be to an increase in the price of heated or larger dwelling units.

2.6.4 ALTERNATIVE METHODS OF COMPUTING PRICE

Another group of studies include price terms as independent variables in housing demand models. Seven different methods can be discerned from the literature, each emphasizing different sources of price variation as discussed in Section 2.6.1.

(i) Metro-wide Price Indices. Several researchers have worked with a national sample of households drawn from several large cities.[14] For each city, one can get renter and owner-occupier shelter price components from the consumer price index.[15] All households in the same city are implicitly assumed to face the same prices for renting or owning. The only variations in prices are assumed to be from one city to the next. Presumably, price variations are seen to exist only because of inter-city variations in building material costs, building technologies, or zoning/building bylaws. Polinsky (1977) shows that demand models with metro-wide price indices tend to overstate the effects of income and price changes on housing demand because they are mis-specified.

(ii) Hedonic Price Indices. In Section 2.1.2, the 'hedonic price discounting' method of de Leeuw and Struyk (1975) is described. De Leeuw and Struyk used this approach to convert rental expenditures into a measure of housing demand. Follain (1979 and 1982) uses a similar procedure to construct a price variable to include in a demand function. Unlike the metro-wide price indices, it is possible to have a different price for every household in the sample, even among households residing in the same city. In Follain's procedure, a household has paid a higher price if what it has paid exceeds what other households in the metropolitan area have paid for housing with similar

characteristics.[16] Such price variations presumably reflect disequilibrium in the market. These variations may also reflect localized (i.e. intra-city) differences in building costs or zoning/building bylaws.

(iii) Tax Differentials. As noted earlier, the price for housing depends in part on its tax treatment. Two approaches to handling tax differentials have been considered. One approach distinguishes between the pretax (PT) price and the aftertax (AT) price of housing. Rosen (1979a) notes that, under certain assumptions, AT = (1-rs)PT for owner-occupier housing in the U.S. where 'r' is the consumer's budget share for housing and 's' is the consumer's marginal tax rate.[17] Rosen (1979a and 1979b), King (1980), and Boehm (1981) all use this transformation from PT to AT. The second approach is exemplified by Boehm and McKenzie (1982). They introduce PT and the consumer's marginal tax rate as two separate independent variables in a housing demand model.

(iv) Subsidy Differentials. The Housing Allowance and Demand Experiment (HADE), described in Section 2.5.2 above, offers another way of calculating a price for each consumer. As outlined in Cronin (1982: pp 98-99), HADE offered subsidies to low income renter households according to either a 'housing gap' or 'percentage of rent' formula. In either case, it is possible to think of the subsidy as reducing the effective price of housing, in a manner not unlike the distinction between pretax and aftertax prices in (iii) above. Friedman and Weinberg (1981) and Cronin (1982) invent a technique for estimating the sensitivity of demand to the size of the subsidy and hence to price. They ignore, however, any other sources of price variation.

(v) Use of Assessment Ratios. King (1980), in a study of the U.K. housing market, used data on the 'gross rateable value' (GRV) of a dwelling. The GRV is an assessment of its rental value provided by an official assessor. King assumes that the GRV is a measure of the level of housing services provided (quality, as used in this paper). If the building is currently being rented for an amount A (summing over all tenants), King calculates the price of housing as P = A/GRV. If P>1, the tenants are paying more than the assessor expected and if P<1 then the contrary is true. King apparently thinks these price differences arise because of disequilibrium: people paying more or less for housing than 'expected'. However, the basis for the assessor's valuation is not

clear. Is the assessor taking into account local variations in building costs, building technology, zoning/building bylaws, or location in computing these GRV? If any of these are being considered by the assessor, then the GRV will include part of the variation that should be in P.

(vi) Cost Function Approach. In Section 2.1.2, the 'cost function discounting' approach of Polinsky and Ellwood (1977) is discussed. By assuming competitive markets in long run equilibrium, they are able to come up with a price index for each property. For each property, one must know the cost (per m^2) of land, the cost (per m^2) of constructing residential floorspace, and the form of the housing production function. Polinsky and Ellwood assume the same production function for every unit of housing. Therefore, their price index varies from one dwelling to the next only as land costs and floorspace costs vary. However, some of their 'price variation' would, in fact, be quality variation as we use the term. For example, some land price variation reflects location and some of the floorspace construction costs reflect variations in the quality of construction. There is, further, no allowance in this approach for price variations arising from disequilibrium.

(vii) Spatial Price Approach. The above approaches do not treats location explicitly as a quality attribute, nor do they control for it in estimating price. Straszheim (1973 and 1975) and Quigley (1976) have proposed approaches to this. Straszheim notes that, in a spatial equilibrium, housing costs vary with location because of differential costs of commuting (or other forms of trip making). Therefore, a consumer chooses a dwelling by trading off commuting costs against different kinds of housing costs, rather than simply housing costs alone. Straszheim controls for location by calculating 'standardized' prices. A standardized price is the price of a housing unit with specified characteristics and a particular location with respect to the consumer's workplace.[18] Straszheim uses these standardized prices in his demand functions; in other words, he does not use the prices the consumer actually pays because of the effect of location. Quigley (1976) uses a 'gross price' approach. He sums the housing cost and the commuting cost of a given dwelling to get a gross price. Quigley argues that a consumer makes two choices: type of dwelling and location. He believes that the consumer will tend to choose a dwelling of a certain type if it has the minimum gross price of all dwellings of

that type. Further, the consumer will trade off among different dwelling types by comparing the features of each dwelling type against its minimum gross price. Thus, Quigley uses the minimum gross prices for each dwelling type in the housing demand equation rather than the actual prices the consumer pays. In both approaches, two different consumers may well face different prices for the same dwelling depending on their commuting costs from the dwelling. These two approaches attempt to control for the impact of location on price. However, these approaches neglect the other factors that also create quality variation. In their models, such quality variations are mistakenly interpreted as price variations.

2.7 INCOME AND DEMAND

Much of the literature has emphasized the role of income in shaping housing demand. Income, or more correctly the ability to afford, is widely seen as an important determinant of demand. Unfortunately, there seem to be almost as many different concepts of income as there are housing demand studies. In large part, these differences arise because of differences in the way that a consumer's ability to afford is perceived.

The design of many of the datasets used in housing demand research exacerbates this problem. In a typical survey, the household is asked about its current dwelling and its income in the preceding year or calendar year. Thus, a household's dwelling choice ends up being linked to an income that may not reflect its current ability to afford. For many households this is not a problem, because their current income bears some resemblance to the previous year's. However, for certain groups such as the young, the unemployed, or the recently-retired, the measurement problem can be significant.

Three different classes of income measures have been employed in attempts to get a good affordability-to-afford measure: those measures based on (1) current income, (2) an augmented current income, and (3) a 'permanent' income. The last of these leads naturally into a discussion of the role of wealth in housing demand.

2.7.1 INCOME MEASURES BASED ON CURRENT INCOME

Perhaps the most widely used measure is gross income. Although the definition does vary somewhat among surveys, gross income typically includes wages and salaries, self-employment income, net income from investment, government transfer payments, private pensions and other benefits, and miscellaneous income. It typically does not include capital gains, transfer payments or gifts from relatives or friends, nonpecuniary job benefits such as a company car, or the imputed interest on equity in an owner-occupied dwelling. It also does not consider as income the liquidation of assets: e.g. selling a used car to get money to buy something else. In certain circumstances, it can be argued that some or all of these help to determine ability-to-afford.

Even if we agree on the items to be included in an ability to afford measure, there remains the question of the individuals over whom it is measured. Some researchers use gross household income: the sum of the incomes of all household members.[19] Others prefer to use the income of (1) the head of household alone, (2) the head and spouse if any, (3) the primary nuclear family, or (4) the primary economic family.[20] The disagreement here has two bases. First, there is a debate as to whether the incomes of secondary individuals (those outside the primary nuclear, or economic, family) are taken into account when a household chooses a dwelling. Second, there is disagreement as to whether the incomes of other primary nuclear family members (i.e. spouse and/or children) should be regarded as transitory or 'permanent' (the notion of permanent income is discussed in the next section).[21]

Finally, there is a lack of uniformity in the treatment of taxes. Some analysts have used gross income while others have used income net of taxes.[22] Presumably, net income is a better measure of ability to afford. Net income, however, is not a frequently collected datum in housing demand surveys. Further, net income is not necessarily a good indicator of what is 'disposable' if we equate disposable with 'take home' pay. In part, this is because of the range of other payroll deductions -- pension, medical insurance, union fees, and so on -- which can vary substantially from one worker to the next. In part, it is also because of tax schemes like RRSP and RHOSP which can reduce taxes at yearend, albeit with a cashflow consideration, leading to an overestimate of 'take home' during the year.

2.7.2 INCOME MEASURES BASED ON AUGMENTED CURRENT INCOME

Because income as defined above may not be a good indicator of ability to afford, a number of analysts have attempted to extend this measure by including other components.

The most frequently cited shortcoming of current income definitions is that they ignore the imputed income on a home owner's equity. The argument is well-known. If a household were to choose to rent, it could invest the foregone downpayment and earn income from it. By instead choosing to own, the household can be thought of as a landlord collecting an imputed rent from itself as the tenant. It is incorrect to assume, therefore, that two households, a renter and an owner, with the same measured income have the same ability to afford.

Several studies have estimated the imputed income from home ownership.[23] The problem here is in estimating just how large the imputed rent is. Most studies use 6% of the household's equity. However, there is no discussion of why 6% or any other figure is appropriate.

Few analysts have tried to include other income components as well. Lee and Kong (1977: p 302) define a 'full income' which includes 'regular money income, imputed rental value of the owner-occupied home equity, rental value of housing received free of charge, value of free help received, and total amounts saved on car repairs, additions and repairs to home, meals at work or school, home-produced food, government food stamps, and other free food'. However, no additional details are provided on the calculation of these amounts for individual households.

2.7.3 INCOME MEASURES BASED ON PERMANENT INCOME

Artle and Varaiya (1978: p 38) present a lucid rationale for the use of permanent income.

> "In Irving Fisher's 'ideal loan market', a household's consumable resources are defined by its wealth. At any point in time, the household's wealth is defined as the sum of its nonhuman wealth, net liabilities, and the present value of its prospective earnings from work. Within the bound of solvency set by this concept of wealth, the Fisherian household will engage in borrowing and lending (saving and dissaving) in order to make its rate of consumption 'more nearly uniform' over time.
>
> Modigliani and Brumberg [Utility Analysis and the

> Consumption Function: An Interpretation of Cross-section Data. In K. Kurihara, ed. (1954). Post-Keynesian Economics. Rutgers University Press] elaborated on this idea and formulated what has since become known as the life cycle theory of saving and consumption. A major tenet of their theory holds that an individual's current rate of consumption and saving can be satisfactorily explained, not by the individual's current rate of income, but by the individual's current position - described by age and present wealth - in the life cycle. In particular, the role of savings is to serve as a cushion against variations in income during the life cycle, and to provide for retirement and emergencies."

The concept of permanent income is attractive but it is also difficult to operationalize. To estimate it directly, one must know the consumer's future earnings stream. At best, we know the consumer's recent history of earnings.[24] In the absence of data about the future, how can a permanent income measure be derived? The following six approaches have been used.

(i) Normal Income. A 'normal' income is defined to be the income received by a household in an ordinary year. Usually, it is calculated as a simple average of the incomes received over a number of years. The intent is to average out small variations in income from one year to the next arising from unemployment, illness, unusual overtime pay, and so on. Normal income is arguably like a household's permanent income in that it smoothes out some of the variability in current income.[25] Other analysts use a 'weighted' normal income measure which assigns a larger weight to more recent incomes.[26] The idea here is to approximate the household's own perception of its normal income, in the belief that the household is strongly influenced by more recent events.

(ii) Expenditures. The Fisherian household consumes at a level corresponding to its permanent income. Therefore, in the absence of better data, the household's level of expenditures can be a proxy for its permanent income. Byatt et al (1973) adopt such an approach using data from the British 'Family Expenditure Survey'. Kain and Quigley (1975: chapter 6) assume that housing expenditures are a large and relatively fixed proportion of total expenditure and thus can also be used to proxy differences in permanent income.

(iii) Neighbourhood Averaging. In this approach, it is assumed that the household's permanent income can be approximated by the average income of

households living in the same neighbourhood. It is presumed that households live in homogeneous neighbourhoods so that the neighbourhood average represents what the household's income would have been like without its transitory component. Wilkinson (1973) uses this approach to compute permanent incomes.

(iv) Mortgage Application Data. Several researchers have based their analyses on mortgage application data. It is not untypical for such applications to include data on expected future income. The U.S. Federal Housing Administration mortgage insurance application procedure, for example, includes an assessment of the borrower's 'effective income', the typical income expected by the household over the first third of the mortgage term. This data source has been widely used.[27] A somewhat similar data source in the U.K. is described in Byatt et al (1973).

(v) Cohort Regression Analysis. Another approach is to group households into cohorts. Assuming that the cohorts have been designated to include households with the same permanent income, the average income in that cohort should resemble the permanent income. Steele (1979: pp 65-71) is arguably the best example of this approach. Steele first estimates regression equations, one for each of a combination of sex and level of schooling of the head of household. In each, income (Y) is regressed against household characteristics including the age, labour force status, and occupation of head as well as whether the primary source of income is from investment or self-employment. For each household, an expected income (EY) can be calculated from the appropriate regression equation. The future pattern of expected income can also then be calculated. Steele then employs the following definition for permanent income (PY).

$$(3) \qquad PY(t) = r\left[\sum_{j=t}^{D} EY(j)\left\{\frac{1+r}{1+g}\right\}^{-[j-t]} + [Y(t)-EY(t)]\right]$$

The subscripts (t and j) denote ages of head, 'r' is real interest rate, 'g' is the rate of growth of real income, and D is the expected age at death. Others using a cohort regression analysis include Kain and Quigley (1975), Struyk (1976), Follain (1979), Ihlanfeldt (1981), and Boehm and McKenzie

(1982). These others, however, use the expected income, EY, as their permanent income measure rather than PY as does Steele.

(vi) Instrumental Variables Approach. Lee (1968) describes an extension of the Instrumental Variable method of Livitan which permits an estimate of the impact of permanent income without actually calculating permanent income per se. Basically, income in some other year (typically lagged) is used as an 'instrumental variable'. Livitan's method estimates the slope coefficient of permanent income by the ratio of the correlations between (1) housing demand and lagged income and (2) current income and lagged income. Byatt et al (1973) and Lee and Kong (1977) also have employed this approach.

Muth (1974) has a different perspective on 'permanent income'. He argues that, when a household is considering a new dwelling choice, it takes into account its expected duration of residence. It looks at the income it expects to earn while residing in that dwelling, not the complete set of future lifetime earnings as suggested by other analysts. Given some uncertainty about how long the household will stay there, the household effectively attaches weights to expected future incomes: larger weights for near future incomes and smaller weights for incomes further into the future. Muth argues that a permanent income measure should reflect the expected duration of residence of a household. The relationship between housing demand and residential mobility is explored further in Section 3.3 below.

2.7.4 WEALTH AND HOUSING DEMAND

Attempts to measure permanent income highlight the role of wealth in housing demand. Anecdotal examples abound of consumers living in housing which is beyond any reasonable ability-to-pay from current income. Some of these may be people with exceptionally strong preferences for housing. However, a frequent argument forwarded is that current income is not a good guide to future earnings or to accumulated wealth.

In spite of this, very little explicit recognition has been given to the role of wealth in empirical housing demand studies. In large part, this is due to the notable absence of questions on wealth in recent housing demand surveys. In part, this is due to a fear among survey designers that

respondents are unwilling to supply such detailed information. In part, there are also concerns that the typical consumer may not have a good idea of its extent of asset-holding and indebtedness. Usually, the closest thing to a question on wealth concerns the consumer's net income from investment. Boehm and McKenzie (1982), for example, use net income from investment as a proxy for wealth in their housing demand model.

Statistics Canada (1974) and Bossons (1978) are among the only studies in which wealth data are used in the estimation of a housing demand model. Both studies examine tenure choice only and both conclude that wealth has an important (though nonlinear) effect on the propensity to be an owner-occupier. However, both studies also include current income as a variable and thus risk multicollinearity. To some extent, wealth is correlated with current income and this reduces our ability to separate the influence of wealth from that of income. Also, such studies have been criticized on the grounds that, because of inflation in the owner-occupier housing market, consumers who became home owners several years ago now are wealthier than their peers who chose to remain renters. This argument sees wealth as being partly determined by tenure choice, not the opposite as housing demand studies assume. More empirical work needs to be done to clarify the role of wealth in shaping housing demand.

3. FORMULATION OF THE DEMAND FUNCTION

In this section, the formulation of a housing demand function is discussed. Some alternative structural forms for the demand function are considered in Section 3.1. Several analysts have found that price and inocme elasticities vary among different demographic groups. In Section 3.2, the possibility of linking these differences to the specification of a demand function is discussed. The relationships among demographic characteristics, housing demand, and residential mobility are discussed in Section 3.3. Finally, a discussion is presented in Section 3.4 of the economic factors, other than prices and incomes, that have been considered in housing demand functions.

3.1 STRUCTURAL FORM

In Section 2.1.1 above, the consumer's demand for housing is written simply as $q = f(p,y,x,z)$ where q is the quantity demanded, p is the price of housing, y is the consumer's income, x is the set of prices of other commodities, and z is a set of preference parameters. This is a convenient and standard way of summarizing the kinds of factors that shape any demand function. However, to operationalize this concept, it is necessary to specify a numerical form for the function 'f'.

In the remainder of Section 3.1, we consider three classes of demand functions. First, linear and log-linear demand models are reviewed. Next, logit, probit, and other nonlinear models are described. Finally, an alternative approach entitled 'linear expenditure systems' are highlighted. These three classes are presented in the order in which they have appeared in the literature. In certain senses, each is an extension of, and an attempt to resolve problems with, those preceding it.

3.1.1 LINEAR AND LOG-LINEAR MODELS

One approach is to use the following linear approximation.

$$(4) \qquad q = a_1 + a_2 p + a_3 y + \sum_{m=1}^{M} b_m x_m + \sum_{n=1}^{N} c_n z_n$$

Here, it is presumed that there are M other prices and N preference parameters. Variations of this linear approximation have been widely used in housing research. Researchers differ in the number and kinds of preference parameters and other prices included. Also, a substantial number of analysts have not included housing or other prices (see Sections 2.6.2 and 2.6.3).[28]

Other analysts prefer a log-linear function.[29] The demand function is the same as that shown above except that q, p, y, x, and z are in logarithmic form.[30] The often-cited advantage of the log-linear function is that its slope coefficients are elasticities. For example, if the income coefficient, a_3, is 0.6, a one percent increase in the consumer's income leads to an increase in housing demand of 0.6 percent. In the linear model,

the income elasticity is given by a_3YAVG/QAVG where YAVG and QAVG represent the mean income and housing demand, respectively, of a cohort of consumers. While admittedly more work, the calculation of an elasticity for the linear form is fairly simple. There is little else on which to prefer either the linear or log-linear form.[31]

The primary reason for considering still other functional forms has been the nature of the dependent variable, the quantity of housing demanded. As discussed in Section 2.1.4, demand is often represented as a binary choice: e.g. the consumer chooses owner-occupancy or not, a three-bedroom dwelling or not, or a new dwelling or not. In such cases, 'q' is usually a zero/one dependent variable. It is difficult to apply a log-linear model here because the logarithm of zero is undefined. Further, it is difficult to use the linear model because binary dependent variables violate several assumptions on which linear regression, the statistical estimation method typically applied, is based.[32]

3.1.2 LOGIT, PROBIT, AND OTHER NONLINEAR MODELS

In recent years, logit and probit models have become increasingly popular in housing demand research.[33] These model the probability (v) that a consumer makes a certain discrete housing choice. They take the following form.

(5) $v = f(w)$ where

(6) $$w = a_1 + a_2 p + a_3 y + \sum_{m=1}^{M} b_m x_m + \sum_{n=1}^{N} c_n z_n$$

Here, w is a 'likelihood index function'. The larger is w, the higher the probability, v, of choosing that alternative. The function f(w) transforms this index into v. In the probit model, f(w) is given by the cumulative Normal distribution (evaluated at w). In the logit model, f(w) is given by

(7) $$f(w) = e^w/(1+e^w)$$

One never observes the probability that a consumer makes a certain

housing choice; one observes only that a certain choice was made. The objective in logit and probit models is to find a likelihood index function that generates probabilities as close to one for consumers who made that choice, and as close to zero for the others, as is possible. Maximum likelihood techniques are used to do this.

The calculation of an income or price elasticity in a logit or probit model is straightforward. As an example, the income elasticity in the logit model is given by $a_3 y (1-v)$ where y is, as before, the income of the consumer, and v is the estimated probability of making a certain housing choice. These elasticities are somewhat more understandable than are the coefficients of the likelihood index function itself.

The logit and probit models assume an S, or reverse-S, relationship between each independent variable and the dependent variable. The two tails of the S are v=0 and v=1 and changes in an independent variable are seen to cause v to move between these two limits. There is nothing magical or essential about the logit and probit models; any mathematical function with the an S shape may be used. Bossons (1978), for example, uses a 'cubic spline' function to fit basically S-shaped relationships between tenure choice and each of (1) income and (2) wealth. Ihlanfeldt (1980) similarly uses dummy income variables, rather than simply an annual dollar amount, to allow for nonlinearity in the effect of income on housing choice.

3.1.3 LINEAR EXPENDITURE SYSTEMS

The notion of linear expenditure systems first arose in national econometric modelling of consumer demand. The idea was to develop a consistent set of consumer demand equations: 'consistent' in the sense that a price change in one commodity, or an income change, would lead to a set of consumer demands that were still consistent with the consumer's budget constraint. A popular version is the Stone-Geary system. Recently, Mayo (1981) and Cronin (1982) suggested use of the Stone-Geary system to analyze housing demand. Let us briefly review this system and then consider why it might be a useful approach to housing demand.

In the Stone-Geary system, the consumer is assumed to maximize the following utility function:

(8) $U = (H-h)^a(X-x)^{1-a}$ $\quad 0<a<1, \quad h \leq H, \quad x \leq X$

Here, H and X are the physical amounts of housing and other goods consumed and U is the utility level achieved. There are three parameters: a, h, and x. The parameter 'a' reflects the relative preference for housing; the larger is 'a', the more housing is preferred relative to other goods. The parameters 'h' and 'x' can be thought of as 'minimum' amounts housing and other goods to be consumed. If the consumer has H=h and X=x, then U=0. Higher utility levels are achievable only if H>h and X>x. With an income of Y and facing prices P_h and P_x for housing and other goods respectively, the utility-maximizing Stone-Geary consumer can be shown to have the following housing demand function:

(9) $H = (1-a)h + a(Y/P_h) - a(P_x x/P_h)$

There are two methods of estimation for this demand function. One approach is to estimate the model

(10) $H = b_1 + b_2(Y/P_h) + b_3(P_x/P_h)$

and then calculate b, h, and x from the estimated b_1, b_2, and b_3. The second approach is to use other data to estimate some or all of b, h, and x and then substitute these back into the demand equation. The first of these approaches essentially reduces the Stone-Geary system to a linear demand equation of the type discussed in Section 3.1.1 above.

What makes the Stone-Geary system different from the other demand models considered so far is its focus on three preference parameters: b, h, and x. These parameters offer a way of systematically considering differences in price and income sensitivity among households. We return to this issue shortly.

3.2 RELEVANT DEMOGRAPHIC GROUPS

There is widespread evidence that there is no unique income or price elasticity of demand. David (1962: pp 53-81) was one of the first to examine

interrelationships among income, tenure, household composition and the demand for housing. He concludes (p 81):

> " In summary, increasing family size is associated with a decline in expenditures on housing. Our previous analysis shows that this decline results from the consumption of more rooms and less quality in housing. For renters both the change in size of house occupied and the change in quality ae marked. For home owners, large changes in the quality of housing consumed and little change in the size of dwelling is observed with a change in family size. As family size increases, the renter appears to benefit from appreciable economies of scale which occur in the renting of large dwellings. Such economies of scale reduce the expenditures of the large renting family below what might be expected on the basis of quality adjustments alone.
>
> As age, family size, and marital status affect whether a family owns or rents its housing space, it is clear that family composition has a significant impact on the character of consumption of housing."

Since David's pioneering work, several analysts have found confirming evidence of demand elasticity variations among different groups of consumers. These are discussed in greater detail in Section 4 below.

While there is sufficient evidence to suggest that different groups of consumers have different demand elasticities, an important question remains. How should the demand function be formulated to take into account such differences? There would appear to be three different approaches: two of them have been used to date and a third is based on Mayo's reflections on the Stone-Geary system.

One commonly used approach is based on formulation (4) in Section 3.1.1. There, a set of z_i's are defined to be preference parameters. It is assumed that these parameters vary systematically with the demographic, income, or tenure characteristics of the consumer. Many analysts therefore replace the z_i's with variates (denoted d_i) such as the age of the household head, household size, income, tenure, and so on. In other words, the following demand model is hypothesized:

$$(11) \qquad q = a_1 + a_2 p + a_3 y + \sum_{m=1}^{M} b_m x_m + \sum_{n=1}^{N} c_n d_n$$

The second commonly used approach is to estimate separate demand equations for each cohort. The estimated model is thus the following:

$$(12) \qquad q = a_{1c} + a_{2c} p + a_{3c} y + \sum^{M} b_{mc} x_m$$

Equation (12) differs from (11) in that the intercept and the slope coefficients for prices and income vary from one cohort to the next. This is an important distinction. If model (11) is used in its log-linear version, then every consumer is assumed to have the same income and price elasticities, even though demand varies by cohort group. Using (12), it is possible to have a different income or price elasticity for each cohort.

In my own work, I have preferred to use (12) for this reason. However, there are two problems. First, one typically ends up with a substantial number of income or price elasticities without much understanding of why these elasticities vary from one cohort to the next. Second, since many different kinds of cohort definitions have been used, the numerous studies of this type to date lack close comparability. These two problems are, in fact, different manifestations of a common basic question. Why do demand elasticities differ among households? If we could answer this question, it should be possible to construct a model which systematically explains demand elasticities as a function of household characteristics.

This is where Mayo's reflections are useful. He (1981: pp 110) states:

> " The diverse nature of findings regarding demographic variables is not surprising, given the ad hoc way in which their effects have been accounted for in the literature. A more productive line of investigation than that suggested by the empiricism of the literature may be found in attempting to parameterize plausible utility functions using demographic variables to 'translate' parmeters ... and thus allow their effects to be accounted for in a more theoretically well-founded way. For example, in the Stone-Geary function the parameters that are often interpreted as 'minimum subsistence levels' ... could be made continuous functions of household size. This would lead to demand functions that accounted directly for the possibility of varying price and income responses not only with levels of price and income but with household size as well."

Mayo is suggesting that the demand equation (9) above be estimated in a two step procedure. In the first step, the minimum consumption levels, h and x, of housing and other goods are determined by household size (and possibly other household characteristics). In the second step, the best-fitting value for the preference parameter 'a' in (9) is found.

Mayo's approach has some distinct advantages over models (11) and (12). First, unlike (11), Mayo's approach allows cohorts of households to have different income and price elasticities because these can be shown to depend

on the preference parameters h and x which differ among cohorts. Second, unlike (12), Mayo's approach generates income and price elasticities which vary systematically among cohorts because h and x are assumed to vary smoothly with household size and other characteristics.

3.3 DEMOGRAPHIC GROUPS, RESIDENTIAL MOBILITY, AND HOUSING DEMAND

It is not uncommon for analysts to take a consumer's history of residential mobility into account in estimating the demand for housing. We have already seen an example of this in Section 2.3.3 where the practice of looking at the housing choices of recent movers was considered. Other analysts have opted to look at the housing choices of all households but to include a variable in the housing demand equation denoting duration of residence.

One of these is Follain (1982) who, in a tenure choice model, includes a dummy independent variable (0 if the household had not moved in the preceding year and 1 if it had). This variable was found to be highly significant. Even after controlling for (i) the age of the head of household, (ii) household size, (iii) household income, and (iv) the relative costs of owning and renting, those households who had moved recently were much more likely to be renters.

Others include Boehm and McKenzie (1982), who restricted their sample to recent movers. They also include a dummy independent variable in their tenure choice model to measure whether the household intends to move again in the near future. They find that households intending to move again soon are much more likely to be renters, even after controlling for a number of other variables as in Follain.

Should tenure choice models, or other housing demand models for that matter, include residential mobility variables? On the one hand, it seems reasonable. After all, households that are likely to move probably prefer housing that is easy to dispose of. Owner-occupied housing typically has high transactions costs (broker's fees, land taxes, and legal, survey and mortgage costs) and may be illiquid. Rental housing may thus be preferable. Viewed in this way, residential mobility may be an important determinant of tenure choice. However, a different story can also be envisaged. Some households

make a choice between owning and renting in the knowledge that they are more likely to move again soon if they rent. Buying a house is associated in popular jargon with 'settling down'. In this view, it is the tenure decision which generates a future pattern of mobility.

Does mobility determine tenure or does tenure determine mobility? If one assumes the latter, then including a mobility variable in a tenure choice model is inappropriate. This may seem to be a minor point. However, as argued by Boehm (1981), it raises questions about the interpretation of many demographic variables in housing demand studies. Boehm (1981: p 376) argues:

> "Thus, the probability that a household makes a given tenure choice and expects to move should be estimated as a simultaneous system of equations. In past analyses, a failure to consider this interaction has resulted in incorrect interpretations of the impact of socioeconomic factors on mobility and tenure decisions. For example, in previous studies age of the household head has always been one of the most significant variables in the determination of tenure choice. However, this analysis demonstrates that age was merely a proxy for the expected mobility and wealth of the family."

Boehm's analysis calls into question the kinds of demographic variables that should be included in a housing demand equation. He argues that the inclusion of both (i) wealth and mobility data and (ii) age-of-head data is redundant. But, which of these two should be included? Boehm apparently believes that the former are better. Others might argue differently.

3.4 ECONOMIC FACTORS OTHER THAN PRICE AND INCOME

In the conventional economic paradigm, demand is a function of prices, income, and preferences. However, a more complicated scenario arises because of the split nature of housing demand as both a consumption good and an asset. When a household chooses between renting and ownership, several factors come into play: the different tax treatments accorded to the two modes of tenure, mortgage rates and credit availability, the transactions cost of purchasing as opposed to renting, the equity available to put into a purchased dwelling, and any anticipated capital gains associated with homeownership.

In some senses, we can think of these as price elements. Indeed, some analysts have gone to great lengths to construct prices for owner-occupied and rental dwellings which reflect some of these considerations. Struyk (1976: pp 505-506) develops as 'prices' several measures of the tax subsidy implicit in

home ownership. Rosen (1979a) and King (1980) develop an aftertax price of housing which is included directly into a tenure choice model.

Other analysts have preferred to treat these elements as separate independent variables in a housing demand model. Boehm and McKenzie (1982) include the consumer's marginal tax rate as an independent variable separate from the price of housing although Rosen or King would argue that it is part of the aftertax price of housing. Hendershott (1980) and Rosen and Rosen (1980) include credit availability as a separate independent variable in their tenure choice models. King (1980) also allows for rationing of credit (and of public housing) in his demand model. The capital gain attendant upon house price inflation is treated as an independent variable by several authors including Diamond (1978 and 1980), Rosen and Rosen (1980), Boehm (1981), Boehm and McKenzie (1982), and Follain (1982). Finally, Boehm (1981) and Boehm and McKenzie (1982) suggest that an owner's equity in a previous home affects the size of a downpayment on a new home, thereby affecting the household's demand.

An interesting debate in the housing demand literature centers on the impact of inflation on tenure choice. In inflationary periods, there is an incentive to purchase housing because of the enhanced capital gains. The beneficial tax treatment of these gains is an additional incentive. However, mortgage costs also rise during inflationary periods as lenders attempt to protect their 'real' rate of return. This is a disincentive to home ownership; partly because of the higher interest costs and partly because of the 'real payment tilt' associated with level payment mortgages. In the U.S., the effect of interest payments is ameliorated somewhat by the deductibility of mortgage payments for income tax purposes. Boehm and McKenzie (1982) and Follain (1982) have recently estimated housing demand functions for the U.S. which allow them to analyze the net effect of inflation. Boehm and McKenzie find that the overall impact of inflation is negative: a one percent increase in inflation brings about a three percent reduction in the probability of purchasing among recent movers. Follain finds somewhat similar results although the impact varies with the marginal tax rate of the household and the amount of housing being consumed. He finds that the higher the tax rate or the greater the quantity of housing consumed, the smaller the reduction in demand attendant on an increase in anticipated inflation. In Canada, the impact of inflation would likely be even more negative given the lack of

interest deductibility.

4. EMPIRICAL EVIDENCE ON PRICE AND INCOME ELASTICITIES

Just how sensitive is the demand for housing to price and income change? In the preceding part of this essay, we have considered the many different ways in which demand, prices, and incomes can be measured and a demand function formulated. Further, we have discussed why and how price and income elasticities might vary among cohorts of households. Finally, we have considered a range of different datasets from which elasticities might be calculated. It should not be surprising, in view of this great variability, that elasticity estimates show a considerable degree of variation.

Let us consider here just five of the studies reporting demand elasticities. These have been chosen to exemplify the range of estimates typically found in the literature as well as to highlight some commonly-observed patterns.

4.1 MUTH (1960)

Muth describes an early study of the price and income elasticity of demand. He uses national time series data on housing demand, prices and incomes for the United States from 1914 to 1941. His demand variate is per capita, price-discounted, nonfarm housing stock. His price variable is the Boeckh index of residential construction costs in real terms. His income variable is Friedman's per capita expected real income series. Muth (1960: p 50) concludes:

> ' ... home-building is highly responsive indeed to changes in price or income. Either a 1 per cent fall in price or a 1 per cent increase in income leads to an increase in gross construction of about 5.5 per cent in the same year as the change in price or income.'

4.2 LEE (1968)

Lee examines housing demand using cross sectional data (from the U.S. Survey of Consumer Finances). His dependent variables are house prices and rent expenditure; both unadjusted for price. Disposable income is used as the income measure with Livitan's method employed to approximate the permanent

income elasticity. The income elasticity of housing demand is estimated to range from 0.61 to 0.89 for house value (i.e. home owners) and from 0.46 to 0.58 for rent expenditures.

Lee's income elasticity estimates are considerably below that of Muth. However, it is difficult to compare them because of differences in the measures of housing demand and income used. However, Lee's figures are not atypical of what is found in studies based on micro-data. For reasons that have yet to be fully explained in the literature, elasticity estimates appear to be considerably larger when using aggregated data compared to disaggregated (micro) data.

4.3 DE LEEUW (1971)

De Leeuw examines housing demand using aggregate data for up to 19 metropolitan areas in the U.S. in 1960. His dependent variables are the median rent expenditure and (price-discounted) house value in each metropolitan area. Metro-wide price indices are calculated from the Bureau of Labour Statistics' 'Survey of City-worker Budget Costs'. Median metropolitan incomes are also used. He estimates price and income elasticities by size of household for both renters and owners: some of his estimates are summarized below.

Persons in Household	Income Elasticity		Price Elasticity	
	Owners	Renters	Owners	Renters
1	n.a.	.47	n.a.	-.94
2	.89	.77	n.a.	-.73
3-4	1.40	.81	n.a.	-.69
5	1.51	.98	n.a.	-.73
6 or more	2.01	.72	n.a.	-.68
All Households	1.34	.81	n.a.	-.71

Note: n.a. means that the elasticity was not calculated.

There are several noteworthy features here. (i) The income elasticities are considerably higher than those of Lee; this may be because de Leeuw is using aggregated data. (ii) The income elasticities for owners are much higher than those for renters, an observation made by Lee as well. (iii) The income elasticities increase sharply with household size for both renters and owners.

(iv) The price elasticity is higher for those living alone than for larger-sized renter households.

4.4 STRASZHEIM (1975)

Further supporting evidence on the differences among household cohorts is presented in Straszheim (1975). Straszheim uses cross-sectional data on households in San Francisco. Straszheim uses a 'spatial price approach' as described in Section 2.6.4 above to estimate the housing prices facing consumers. He also includes current household income in his housing demand equations. A separate demand equation is estimated for each of 16 different household cohorts. The dependent variables used included (i) tenure choice, (ii) number of rooms, (iii) age of structure, and (iv), for owners, size of lot. Some of his income and price elasticity estimates are shown below.

Marital Status Age of Head	Household Composition	Income Elasticity Tenure Choice	Income Elasticity Rooms Own	Income Elasticity Rooms Rent	Price Elasticity Tenure Choice
Single All Ages	Alone	.762	n.a.	.186	-.372
	With Others	n.a.	.076	.093	-.889
Separated All Ages	No Children	.175	.086	.060	-.721
	Children	.545	.042	.076	-.564
Married Under 30	No Children	1.189	.103	.095	-1.257
	1 Child	.848	.076	.069	-.606
	2+ Children	.701	.100	.102	-.501
Married 30-39	No Children	.487	.063	.093	-.517
	1 Child	.396	.119	.063	-.462
	2+ Children	.232	.165	.113	-.209
Married 40-49	No Children	.158	.144	.061	-.103
	1 Child	.117	.136	.222	-.109
	2+ Children	.114	.184	.150	.0
Married Over 49	No Children	.147	.168	.144	-.240
	1 Child	.060	.157	.180	-.105
	2+ Children	.132	.257	.088	.0

Note: n.a. means that the elasticity was not calculated.

Source: Reproduced from Straszheim (1975: p 106, 107, 110)

There are several noteworthy features here. (i) The tenure choice income elasticities are low among all cohorts except persons living alone and young families. Other cohorts are unlikely to change tenures as their incomes rise. (ii) In family households, the tenure choice income elasticity declines as the number of children increases. This may be another manifestation of the

inverted - U relationship between household size and housing consumption first noted by David (1962). (iii) In general, the number of rooms occupied is very insensitive to income. Higher income households do not live in dwellings with more rooms although they may have larger or higher quality rooms. Miron (1980 and 1982) presents similar findings among Canadian households. (iv) The price elasticity of tenure choice is large among young couples with no children and among singles living with others. It is these cohorts, therefore, who are most likely to switch tenure if rents change quickly relative to house prices.

4.5 STRUYK (1976)

Struyk also examines tenure choice income elasticities. He uses cross setional data (the 1% 1970 Census public use sample for the Allegheny and Westmoreland county portions of the Pittsburgh SMSA). He uses a permanent income measure in his demand equation but ignores price. Separate demand equations are estimated for each of six household cohorts. His estimated income elasticities for white households (see p 518) are shown below.

	Permanent Household Income				
	$4,000	$8,000	$12,000	$16,000	$20,000
Husband-wife Families					
Head under 30	1.900	1.190	.786	.555	.424
Head 30-44	.847	.700	.576	.464	.331
Head 45-65	.170	.183	.211	.222	.163
Head over 65	.112	.141	.154	.136	.091
Other Families	.091	.168	.232	.268	.335
Primary Individual	.239	.269	.189	.014	-.276

Struyk's estimates complement those of Straszheim above. As with Straszheim, he finds the income elasticity of tenure choice to be highest among young husband-wife families. However, Struyk provides additional detail on how these elasticities vary with income. In general, the income elasticities fall with rising incomes. The higher a household's income, the less likely it is to use that additional income to switch from rental to ownership. This declining elasticity is especially marked among young husband-wife families.

These findings by Straszheim and Struyk indicate that the most volatile component of the rental market are young families. It is they who are the most price sensitive and the most income sensitive. An improvement in income

or an increase in the cost of renting relative to owning will produce a substantial shift into the ownership mode. Other households are substantially less sensitive to price or income change.

5. CONCLUSIONS

In this paper, recent approaches to measuring the price and income sensitivity of housing demand are reviewed. This review has been detailed and technical. There is a danger, in such a review, that broad conclusions are hidden in a myriad of detail. Lest that also happen here, let us conclude by re-iterating the principal findings.

(i) There is a paucity of Canadian research on rental housing demand. Nearly all of the studies reviewed here are based on U.S. data. While there are some similarities among Canadian and U.S. housing markets, there are also some important differences. Among the few housing demand studies of Canadian households are Statistics Canada (1974), Steele (1979), and Miron (1980 and 1982). More work needs to be done to see where the similarities and differences in housing demand are between the United States and Canada.

(ii) Several U.S. studies are based on longitudinal panel data. This permits a direct examination of the impact of changing income, prices, and household composition on housing demand. In cross-section samples, evidence of such impacts is only indirect. There are, however, no large panel data sets available for Canadian households. This severely limits the extent of housing demand research in Canada.

(iii) It is not practical to consider the demand for rental housing without taking into account the extent of substitution between owning and renting. One of the ways that consumers respond to price changes in the rental sector, or to changes in their own incomes, is by switching tenure states. Equally, one of the ways that home owners can respond to higher mortgage or other occupancy costs is by switching to renting.

(iv) The specification of housing demand models varies. Some models include

housing prices, other prices, income, and consumer preferences as independent variables while others exclude one or more of these. Also, a variety of different functional forms have been employed: e.g. linear, log-linear, logit, and probit. The treatment of preference differences among household cohorts has also been handled in a variety of ways. One of the most promising approaches is to use a linear expenditure system, based on the Stone-Geary utility function, to systematically introduce variations in preferences among households which can then be translated into differences in price and income elasticities.

(v) Nearly all demand studies estimate the housing choices of existing households. The impact of a change in price on the decision of an individual or family to form a new household is ignored. Steele (1979) and Miron (1980 and 1982) have examined the impact of income on the decision to live alone and found it to be important. This suggests that such household formation will also be sensitive to price. More research should be carried out on the impact of price on household formation.

(vi) The ability to measure price sensitivity depends critically on the ability to factor rents into quality and price components. Several methods of measuring housing quality have been proposed. Among the best of these are described in Straszheim (1975) and Stevens (1979) where cross-sectional data with intra-urban locational variates are used. However, there are no large cross-sectional data sets for Canada in which location within a city is specified.

(vii) Almost all housing demand studies assume that either recent movers or all households are in equilibrium. There is mixed empirical evidence on this question, however. It would be valuable to know just how sensitive current price and income elasticity estimates are to the assumption of equilibrium.

(viii) There are several estimates available of the price or income elasticity

of demand. However, these estimates are based on several different measures of demand. There are elasticities of (1) rent or house price, (2) price-discounted expenditures, (3) rooms, floor area, or other measures of quality, and (4) tenure choice, dwelling type choice, or other discrete choice measures. The user must be careful not to incorrectly compare these different kinds of elasticities.

(ix) There is a considerable diversity to the way in which income is measured in housing demand studies. Although many analysts agree on the need to measure 'permanent income', this is operationally defined in a number of very different ways. This hinders comparisons of estimates of the income elasticity of demand. In general, the greater the weight attached to current income in the permanent income calculation, the lower the estimated income elasticity of demand.

(x) There are substantial differences in price and income elasticities among cohorts of households. For example, the young husband-wife family appears to be the most volatile in the sense that their tenure choice, and other aspects of their housing demand, is very sensitive to price and to income. Income elasticities also appear to decline at higher incomes and among larger families. David (1962) argues that there is an inverted - U relationship between household size and housing consumption. Subsequent analysis seems to confirm this although there are clearly different inverted - U's at different income levels.

NOTES

1. These include DeLeeuw (1971), Maisel et al (1971), Carliner (1973), Lee and Kong (1977), Lee and Trost (1978), Follain (1979 and 1982), Rosen (1979), Boehm (1981), Boehm and McKenzie (1982)

2. These include Straszheim (1973), DeLeeuw and Struyk (1975: pp 62-66), Gillingham (1975), and Stevens (1979)

3. Among those using binary choice models are Straszheim (1973), Kain and Quigley (1975: pp 122-136, 231-255), Straszheim (1975: pp 91-115), Struyk (1976: pp 47-79), Li (1977), Bossons (1978), Rosen (1979a), Stevens (1979), Ihlanfeldt (1980), King (1980), Boehm and McKenzie (1982), and Follain (1982).

4. Among those using multiple choice models are Quigley (1976: pp 76-102) and Boehm (1981).

5. In practice, there tend to be correlations between housing attributes. Apartments tend to be rented and smaller while detached houses tend to be owned and larger, for example. A model which considers tenure (or any other binary) choice alone may in fact be including the effects of these correlations. In other words, the model may show, for example, a strong effect of income on tenure choice when, in fact, consumers really only want a larger dwelling.

6. See DeLeeuw and Struyk (1975: chapter 3) and MacRae (1982) for further discussion of the properties of housing market equilibrium.

7. Roistacher (1977), Friedman and Weinberg (1979), Hanushek and Quigley (1979 and 1980), and Boehm and McKenzie (1982) use only recent movers in their samples.

8. Of course, this difference will be negative whenever the cost of the basic bundle exceeds a household's income. Presumably, this analysis is applied only to low or moderate income households. Households with higher incomes may in principle be able to afford more but in practice are not expected to spend the remainder of their income on housing.

9. Burke et al (1981, p 7) note that 20% to 30% thresholds have been used in North America although much lower thresholds have been employed in Western Europe and in developing countries.

10. Time did not permit a thorough examination of primary information about these data sources. Instead, a reliance was put on the dataset descriptions found in the housing demand literature.

11. The ensuing description of HADE rests heavily on the accounts of Hanushek and Quigley (1979 and 1980).

12. This approach raises an identification problem. In a hedonic price function, the dwelling value (selling price or rental value as appropriate) is regressed against a set of dwelling characteristics. As discussed in Section 2.6.1 above, some demand modellers relate the same dwelling value strictly to household characteristics. In either case, we can interpret the estimated coefficients. When the hedonic price and demand models are mixed, as in Kain and Quigley or Hanusek and Quigley, the interpretation is more difficult. Does the estimated coefficient of a quality attribute represent a hedonic price, a demand coefficient or some combination of the two?

13. Above, the distinction between ownership and renting has been ignored. Bossons (1978: pp 87-91) discusses the very restricted conditions under which there would be no eonomic reason to prefer one mode over the other.

14. Metro-wide price indices have been used by Rosen (1979a), Follain (1979 and 1982), Boehm (1981), Boehm and McKenzie (1982).

15. These are the same price indices used in "metro-wide price discounting" as described in Section 2.1.2.

16. It is not clear in Follain's paper which housing characteristics were used in the hedonic price equation. Thus, it is not known whether locational characteristics were taken into account. If they were not, Follain's procedure would attribute a higher price to more-central locations.

17. King (1980: pp 142-148) points out that adjustment between aftertax and pretax housing prices may be more complicated than that specified by Rosen. However, King concludes that Rosen's adjustment is about all that can be done with current data. It should also be noted that Rosen's adjustment is based on U.S. tax law. Unlike the U.S., Canadian law does not permit mortgage interest and property tax deductions. The adjustment for Canadian consumers would therefore be different.

18. A household may, for example, be paying $200 per month to rent a dwelling 10 km from the household's worksite. Instead of entering $200 as the price in the demand function, Straszheim enters the rent for a comparable unit at a standardized distance (which might, for instance, be 3.5 km). Each alternative housing choice that the household might have made is similarly priced at the same standardized distance. Thus, these prices control for location.

19. Some studies do not clearly identify the basis for their income variable. It appears that those using gross household income include Lowry et al (1971), Straszheim (1973 and 1975), Quigley (1976), Struyk (1976), Li (1977), Hanushek and Quigley (1979), King (1980), and Miron (1980 and 1982).

20. Byatt et al (1973) and Wilkinson (1973) use different subsets of total household income.

21. There is little evidence available to suggest preferences among these. Wilkinson finds a strong correlation between income of the head and total household income, suggesting that these are interchangeable. Ihlanfeldt (1988: p 190), however, finds evidence that the wife's income did not detract in any way from total household income in his housing demand model.

22. Cronin (1982) deducted taxes and alimony payments. Byatt et al (1973) also presents some results using aftertax income as does Follain (1982).

23. Those including an imputed rent in income include Carliner (1973), Lee and Kong (1977), Roistacher (1977), Lee and Trost (1978), Rosen (1979a and 1979b), and Boehm (1981)

24. One attempt to directly estimate permanent income in a housing demand study is described in Stevens (1979). Stevens was examining the housing choices of Turkish "gastarbeiters" in West Berlin. Given that (1) wages are considerably higher in West Berlin than in Turkey, (2) gastarbeiters are permitted only limited stays in West Germany, and (3) some knowledge of relative wage rates in Turkey and West Berlin, it is possible to estimate the future earnings streams of these gastarbeiters and, hence, their permanent incomes.

25. Lee and Trost (1978), Ihlanfeldt (1980), Friedman and Weinberg (1981), and Cronin (1982) use such an estimate of permanent income. Follain (1979) had reinterview data from the U.S. Annual Housing Survey that allowed him to average incomes from before and after the time that a dwelling choice was observed. Carliner (1973) and Rosen (1979a) also use a normal income approach but first convert all incomes to real data by dividing by the appropriate consumer price index value.

26. Weighted normal incomes are used by Carliner (1973) and Boehm (1981).

27. The FHA data on "effective income" have been used by Maisel et al (1971), Polinsky (1977), Polinsky and Ellwood (1979), and Rosen (1979b).

28. Among those who use a linear demand function with no price variables included are David (1962), Lee (1968), Lowry et al (1971), Kain and Quigley (1975), Struyk (1976), Hanushek and Quigley (1979), Steele (1979), and Miron (1980 and 1982). Those using a linear demand function and including some measure of price are Muth (1960), Lee and Trost (1978), Follain (1979), Friedman and Weinberg (1981), Ihlanfeldt (1981), Boehm and McKenzie (1982), and Follain (1982).

29. Among those using a log-linear model with both price and income terms are DeLeeuw (1971), Maisel et al (1971), Carliner (1973), Straszheim (1973 and

1975), Lee-Kong (1977), Roistacher (1977), Polinsky and Ellwood (1979), Rosen (1979a and 1979b), and Friedman and Weinberg (1981). Byatt et al (1973), Wilkinson (1973), Smith-Campbell (1978), Steele (1979), and Miron (1980 and 1982) have used log-linear models wherein price variables are omitted.

30. Sometimes, preferences are represented by zero-one dummy variables. These can not be logarithmically transformed and are left as zero/one variables in the log-linear estimation.

31. Friedman and Weinberg (1981: p 317) present some comparative price and income elasticity estimates using both linear and log-linear forms. They find that the forms yield very similar estimates. This suggests that there may be no reason to prefer either form.

32. Straszheim (1975) attempts to get around this problem by using a semi-logarithmic model wherein the independent variables are logarithmically transformed but the binary dependent variable is not.

33. Probit or logit models with both price and income variables have been used by Quigley (1976), Rosen (1979a), King (1980), Boehm (1981), Boehm and McKenzie (1982), and Follain (1982). Others using these models, but excluding a price variable, include Li (1977), Lee and Trost (1978), Ihlanfeldt (1980), Miron (1980 and 1982), and Steele (1979).

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